SIGGRAPH 2001

Dynamic Real-Time Deformations using Space & Time Adaptive Sampling

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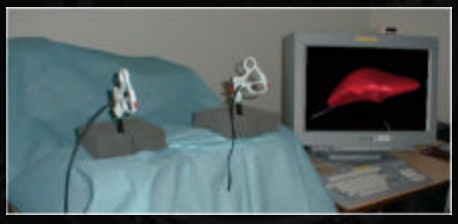
Motivation : surgery simulation



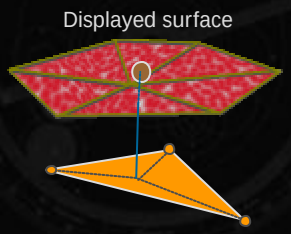
© Epidaure

Consequences

Only ~100 nodes for volume sampling
→ Optimal placement of samples required

Separate surface and internal 3D model
→ Must be linked

How to link with the surface



Challenges

Locally adapt sampling:
- When ? Where ? How ?

Find a physical model:
- Dynamic behavior independent of discretization

Overview

- Multiresolution animation
- Choice of a physical model
- Results

Our method: multiresolution

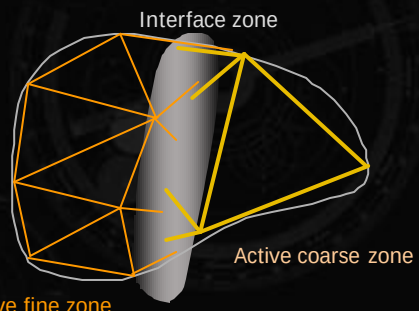
Local adaptivity
- Refinement and simplification

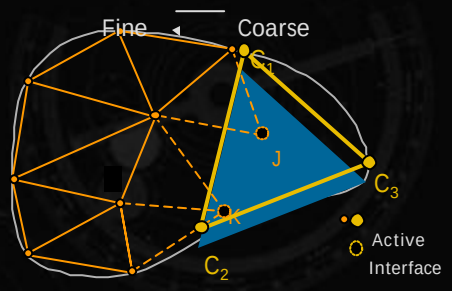
In 3D, mesh subdivision reduces quality

Meshes of the object

Made of tetrahedra
Independent from each other
Optimized quality

Interface between meshes

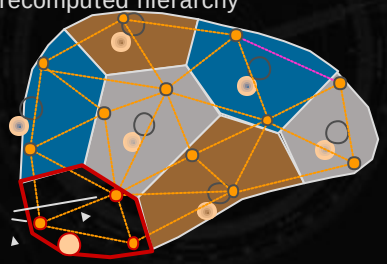




J,K interpolated from $C_1C_2C_3$

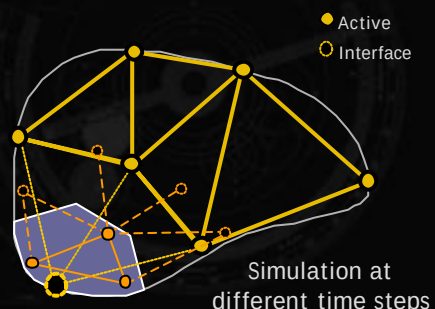
Definition of children

Precomputed hierarchy



Voronoï region

Resulting mesh structure



Simulation at different time steps

Overview

- Multiresolution animation
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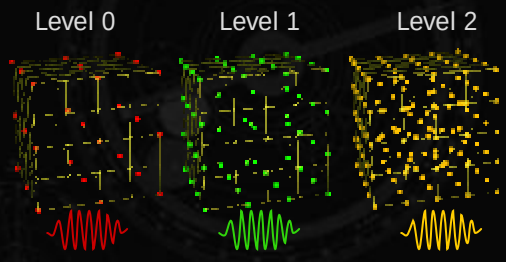
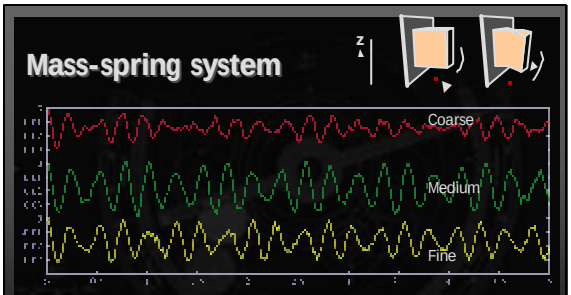
Different discretizations



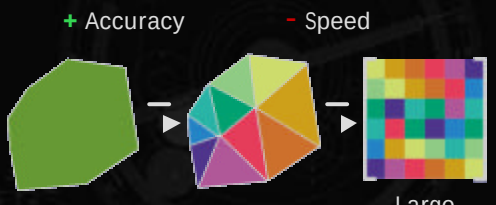
Mass-spring system



« As close as possible » to Finite Elements [Gel98]

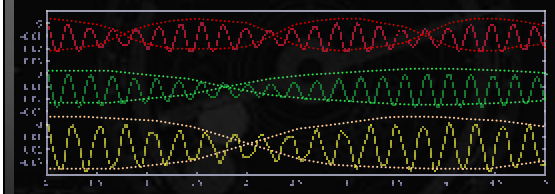
- Amplitude varies
- No smoothness

Classical Finite Elements



Explicit Finite Elements

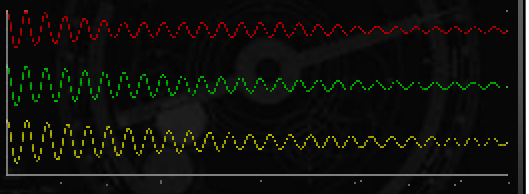
Cauchy tensor



Mass-tensor [Cot97]

Oscillations of the amplitude

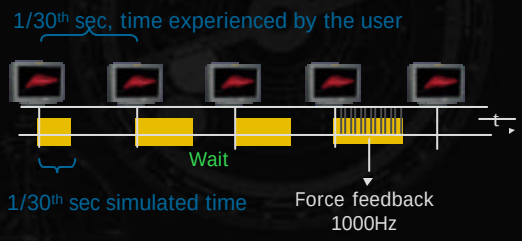
With Rayleigh damping



Multiresolution is preserved

Real-Time simulation

Computation and display are synchronized



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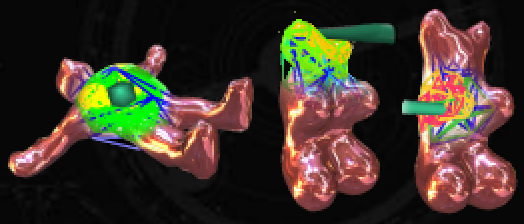
Video



Perspectives

Hierarchical collision detection

Cuts of the object

Validation by surgeons

The surgeon robot © Serre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